



A.D. 1801 . . . . . N<sup>o</sup> 2560.

S P E C I F I C A T I O N

BY

JOSEPH BRAMAH.

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STEAM ENGINES AND BOILERS.  
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**BRAMAH'S SPECIFICATION.**

**TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JOSEPH BRAMAH, of Pimlico, in the County of Middlesex, Engineer, send greeting.**

**WHEREAS** His most Excellent Majesty King George the Third, did, by His Letters Patent under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date at Westminster, the Twenty-eighth day of November, in the forty-second year of His reign, give and grant unto me, the said Joseph Bramah, His especial licence, that I, the said Joseph Bramah, during the term of years therein mentioned, should and lawfully might use, exercise, and vend, within England, Wales, and the Town of Berwick upon  
10 Tweed, my Invention of “**SUNDRY IMPROVEMENTS IN THE CONSTRUCTION OF STEAM ENGINES AND BOILERS USED FOR THE PURPOSE OF GENERATING STEAM, AND FOR OTHER PURPOSES;**” in which said Letters Patent there is contained a proviso obliging me, the said Joseph Bramah, by an instrument in writing under my hand and seal, to cause a particular description of the nature of my said Invention,  
15 and in what manner the same is to be performed, to be inrolled in His Majesty's High Court of Chancery within one calendar month after the date of the said recited Letters Patent.

**NOW KNOW YE,** that in compliance with the said proviso, I, the said Joseph Bramah, do hereby declare that the nature of my said Invention, and  
20 the manner in which the same is to be performed, is herein-after particularly described and ascertained, that is to say:—



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I do not mean to rest the merits of these said improvements on any new principle or effect producible by the operation of steam on this extraordinary machine, which has already reached its present perfection by abler hands ; but, as every improvement which has yet appeared in public use, falls vastly short of that simplicity which a more studious organization will afford, I here declare 5 that this object of simplification has been my chief inducement on this occasion. It is well known by all acquainted with this useful piece of mechanism that all engines heretofore constructed consist of a great complexity of parts, by which they are rendered difficult to understand, tedious to manage, and very troublesome and expensive to keep in perfect working order, especially when in the 10 hands of those of but ordinary skill, and on these accounts are rendered less generally applicable, and productive of public benefit to a less extent than they otherwise would be, provided these objections were judiciously removed. This object, connected with a wish to render the whole expence of this highly valuable machine less formidable, and to enable them with effect to be fabri- 15 cated on much smaller scales than has usually been done, I here declare have been the points I had in view at the commencement of these efforts to promote the public interest, and which points or particulars are principally effected in the following manner, viz<sup>t</sup> :—

First, I propose by one simple handle or lever, only acted upon by two 20 drivers or stops fastened to the plug tree in the usual way, or to any other moving part of the machine, to perform all the offices of the working geer as well in a double as single acting engine. By this improvement the necessity of introducing the usual plurality of handles, levers, rods, axis, and helpers, which render engines so complicated as above stated, will be avoided, and 25 consequently they will not be liable to the objections above alluded to.

Secondly, I use instead of valves, for the purpose of opening and shutting the communication between the boiler and the steam cylinder, and also between the latter and the condensor, hollow cones, made of very hard brass or other proper materials, so contrived and stationed as to be wholly secluded from the 30 action of the outer air in every part, and capable of being turned in any direction from without by means of a spindle or axis passing through an air-tight stuffing box or otherwise ; these cones are ground and fitted into an outer hollow case of iron or other metal, on the principle of a cock, so as to be perfectly air and steam tight when in use. In this outer case is provided a 35 reservoir for the reception of oil or grease, which constantly lubricates the exterior surface of the cone on the inside of said case, and causes it to move freely, and likewise prevents the loss of perfection by its friction with the sides of the outer case, where it moves steam and air tight as aforesaid. These



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cones are sometimes made open at both ends, and sometimes one end is shut and only one open, as the nature of the engine may require. They are likewise made sometimes single and sometimes double, as circumstances or fancy may direct; when single and applied to a single acting engine, the open end of the  
5 cone is presented with its mouth to that part of the steam cylinder where the steam is to enter for the purpose of acting on the piston, and provided this open end be that of the larger diameter of the cone, then the lesser diameter will be the exterior end to which the moving cause must be affixed, and when both the ends of the cone is open there must be a flaunch on the outer case to  
10 receive a cap and air-tight stuffing box through which the motion of the cone is to be communicated as before observed; on the contrary, when the external end of the cone is not open, but left solid, the cap and stuffing box may be dispensed with at the discretion of the maker; but I would in all cases recommend the cap and stuffing-box as a guarantee to keep out the surrounding atmosphere should  
15 the cone through use become imperfect. On opposite sides of the outer case of this cone is united two pipes similar to a stop-cock, one of which leads from said cone to the condensor and the other from it to the boiler, both communicating with the hollow part into which the cone is fitted, so that one pipe conducts the steam from the boiler to the cone, and the other from the cone  
20 to the condensor. Now on one side of this cone is cut an aperture of equal dimensions with the pipes just mentioned, or may be less if necessary, but it must be so cut as to come in exact congruity with the opening or mouth of both the above pipes in the rotation of the cone, when turned about from without, and the distance between the two apertures formed in the outer case  
25 by the mouths of the pipes must equal at least the diameter of the aperture in the cone, in order that as the cone is turned these openings may one of them be shut by the blank or solid side before the other begins to open; the whole being thus equipped, and supposing the aperture of the cone to be turned so as to become coincident with the end of the steam pipe, the steam  
30 will then pass into the cavity of the cone on that side, and of course be carried into the steam cylinder through the open end of the cone, which is at all times presented to it. At the same time the steam, while acting on the piston, cannot escape to the condensor, because the aperture leading thither is kept shut by the blank or solid side of the cone, as above stated, till the engine has  
35 made her stroke, and at which juncture the handle by the stroke of the plug tree or other contrivance, and a proper connection between the handle bar and the axis or spindle by which the cone is moved, suddenly turns the cone so as to first shut the steam pipe, and then station its aperture in exact congruity with the mouth of the condensing pipe, which instantly conveys the steam



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thither, as in all other steam engines, and by the return of the stroke the cone is again driven into its former station, and thus a reciprocal action is kept up, the same as in other engines where valves are used. This cone applied at the bottom of a cylinder, with an open top, completes this part of an atmospheric engine ready for the working geer, which consists of nothing more than one 5 handle, as above mentioned, fixed on a bar or axis in the usual way, and two wooden pulleys properly proportioned, with a leather strap so joined to each as to cause these pulleys (one of which is fixed on the handle bar, and the other on the spindle which turns the cone) to move each other when the handle is carried up or down for the purpose of turning the cone in the way and for 10 the ends already described. This cone, with the same working geer, also answers for a single acting engine, where the elastic force of steam is used, and the atmosphere excluded. In the construction of a double acting engine, one of these cones is stationed at the top and another at the bottom of the steam cylinder, just in the manner already described, with this difference only, that the 15 steam pipe must form a junction with both the cones on one side and the condensing pipe the same on the other side of the outer cases, as above. When this is completed, the same handle, &c. as already mentioned, will completely answer in this instance also, only it will be necessary to adopt such a connecting movement between the external spindles of each cone as will cause them to 20 revolve in opposite directions when the plug tree strikes the handle. This may be accomplished by means of line or strap connected with two wooden pullies in a diagonal direction, or by sundry other common and simple means, particular attention being always paid to the placing the cones previous to their union by this connecting means so that the apertures cut in each, as above directed, may 25 fall exactly opposite to each other when in their active station. It is further necessary to remark that the application of these cones will in every case prevent the engine from being blowed clear of air or water in the usual manner before she starts, and that it will be necessary for the engine builder to contrive a separate communication between the cylinder and the steam pipe in the best 30 manner the situation and local circumstances of the engine will admit, and in no case whatever can this be attended with any difficulty. The double cone is applicable only to engines on the double acting principle, and by which they are rendered exactly the same in the working geer and in the operation of all the external parts as the single acting ones, and are more simple and compact, and 35 expose less quantity of joint or union of parts where air leaks may be apprehended than such as are constructed with two separate single cones stationed as above described; only it must be considered that in applying a double cone instead of the latter, there will be unavoidably a trifling loss of steam propor-



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tioned to the length and diameter of the steam pipe, which must necessarily lead from the station of this cone to the upper and lower extremities of the steam cylinder ; but in this instance the loss here mentioned will be entitled to a drawback when compared with other engines of all that portion of steam  
5 which is constantly exhausted from the cavity, which at each end of the steam cylinder conveys the steam between the cylinder and the valves which perform the office of the cone in question. This double cone is of course composed of the same proper materials as the single ones, and the difference in construction is as follows :—Its length (if for an engine of equal size) must be twice that of  
10 the latter or thereabouts, and in the middle of its length is cast a partition so as to cause it to represent two single cones joined together on one axis, and by this partition one becomes open at the larger end, and shut or solid at the lesser end, while the other is open at the smaller end and shut or solid at the larger. On this account, regard must always be had in determining the  
15 diameter of the said cone, so as to have the mouth of the smaller end of dimensions sufficient either to convey the steam from the boiler to the cylinder, or from the cylinder to the condensing pipe, according to the way the cone may be applied. These cones being separated by the partition as above, constitute two cones as just mentioned, and in each of which is made exactly on the  
20 sides opposite to each other an aperture just the same as in the single cone. This double cone is ground and fitted steam and air tight into an outer case, as in the former instance, and at each end of which is cast a flaunch, one for the reception of the end of the steam pipe, which pipe from its junction with the end of the said outer case completely encompasses the mouth of that end of the  
25 cone presented to it so as to direct the steam into the cavity or interior part of the cone at that end where they meet ; and I prefer in all instances the putting the small end of the cone towards the steam, and the larger towards the condensing pipe which communicated therewith in a similar manner as the former, with this difference only, that the condensing pipe must have a bend or  
30 otherwise such a shape as will allow an air-tight stuffing box for the reception of the spindle or axis by which the cone is to be moved same as in the single cone. At opposite sides of this outer case are cut two apertures, each (four in all) of dimensions equal to those made in the cone within, and at such a distance, &c. from each other as will ensure the apertures in the cone to fall alternately  
35 opposite to or in exact congruity with the former when the cone is turned round to opposite points, as in the instance of single ones ; these holes so cut or cast in the sides of the outer case as aforesaid are then inclosed or covered with a chamber or cap sufficiently spacious to receive the steam through the steam aperture, and also allow it to be discharged through the condensing aperture



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as they are alternately presented, by the turning of the cone within. To these chambers or caps is joined the pipes which conduct the steam from the cone either to the bottom or top of the steam cylinder just as the conducting aperture in the cone is turned about, whether upwards or the contrary, by the action of the moving gear. When the cone is thus mounted in its outer case, as here 5 described, it is easy to see that when the steam aperture is turned upwards the condensing aperture will be downwards, so that while the piston is then pressed upon by the steam on the upper side, the steam below the piston has uninterrupted access to the condenser, and, vice versa, when the cone is turned by the stroke of the plug tree on the handle just half a circle, the steam aperture 10 will then be downwards, and the condensing opening upwards, so that the steam will be then conducted to the bottom of the cylinder and force the piston upward, while the steam above the piston will be open to the condenser as before when the piston made its descent, and thus the action will be kept up with this double cone, as well as where two single ones are applied, 15 as before explained. This species of cone is extremely simple, and cannot fail in being understood, as one of its hollow ends is constantly filled with steam, which is conducted upwards or downwards as the cone is turned for that purpose, while the other end on the contrary side the partition is always open to the condensing pipe, so that as the steam is given in to either end 20 of the steam cylinder by the steam end of the cone, it is conducted away from the other end down into the condenser by turning of the condensing aperture. The advantages of these cones in general in the construction of steam engines must be self-evident to every one who is at all competent to judge, especially the double one last described, as by its application that 25 quantity of external joinings and the various motions which in all other engines are extremely difficult to keep steam and air tight, are here avoided, there being no way where the steam can escape or the air be admitted in but through the single stuffing box through which the axis or spindle which turns the cone within is communicated, and this stuffing box is much more 30 easily kept air and steam tight than the four axis's used to move the valves in common engines. There are other advantages that will attend these cones too tedious to recite in this instrument, but I will mention one of vast importance, viz<sup>t</sup>, they never can at any time be preventing from acting or performing those offices on which the merits and effect of every engine must depend by any casual 35 circumstance that valves are ever subject to, namely, the loss of perfection by a continued hammering against the seat, and their liability to be prevented shutting close by any accidental particles of matter which very frequently fall between the shutting parts; this advantage must be at once obvious to every



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engineer, who too frequently finds the bad consequences of these accidents in the operations of engines made with valves, and which cannot possibly be the case with these cones I propose to use and have described, they having the property of always cleansing themselves by their own action when the engine  
5 works. The third improvement I propose is the peculiar construction of an iron working beam, which is different from any other beam of iron heretofore used, and will add to the utility of engines in many cases, and which is described by a Drawing hereunto annexed. The fourth improvement I propose is in the construction of boilers for generating steam for the supply of engines  
10 and other purposes, and which I mean to perform in manner following, viz<sup>t</sup> :— The necessary dimensions of boilers of every given size I propose to gain by a considerable extension of the bottom or plan on which the fire has its first effect; these bottoms I mean to make in general flat, and not concave, as they now are used. I intend also to rivet, in many instances, to these bottoms  
15 sundry ribs of iron in such a way as will give strength to the bottom of the boiler, and at the same time cause the fire or heated air issuing from the fire-place to make a number of turnings and windings in various directions, so as to arrest the action of the heat on the bottom of the boiler, and prevent that speedy ascent into the flues which is unavoidable in the common way of constructing  
20 and setting boilers used for generating steam. From an attentive perusal of this Specification it will be clearly seen that by the help of the improvements therein stated and described, that steam engines may be easily constructed on even the smallest imaginable scale, and with an effect proportionate to larger ones with respect to use, and by this property the application of these machines  
25 must be greatly extended, and render an additional benefit to society to an incalculable extent. Lastly, I propose to apply steam for the purpose of preventing, in frosty seasons, the freezing of cisterns and pipes belonging to water-closets, and such also as supply dwelling-houses, breweries, distilleries, manufactories, &c., and by this means free inhabitants of large cities and towns  
30 from an inconvenience very detrimental to the domestic comforts of every family in frosty seasons, as well as injurious to trade in many instances, which this application of steam in a proper manner will prevent. In order to accomplish this part of my Invention of a new application of steam, I propose, first, to make a cover for every cistern or reservoir where water is kept for any use, so well  
35 fitted as to contain some degree steam or heated air, at least so tight as to prevent its speedy exhalation when carried thither, so as to retain or cause such steam or heated air to hover or remain so long on the surface of the water contained in such said cisterns as to either thaw or prevent the water in them from being congealed by frost. In the next place I mean to convey all the



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pipes, whatever may be their number, direction, or extent, and whether leading to or from these cisterns, through a hollow case, made of wood, metal, or other materials, brickwork, &c., sufficient to surround them in such a way as to enable me to conduct a current of steam or heated air in such a manner as to cause all the surface on which the frost might have an effect to be immersed in, and 5 kept warm by the said steam or heated air. It will be necessary, in the lowest extremity of this outer case, or in every part thereof, where the water caused by the condensation of steam will be collected, to have an aperture or waste pipe to convey away the said water to some drain or receptacle, otherwise the said outer case would in time become full of water and obstruct the influx of the 10 steam, &c. This being accomplished as here described, a tube or steam pipe from a boiler where the steam is generated, on the principle of the ingenious cooking apparatus made by Mr. William Slark, or in any other manner the situation may require, must be inserted into some part of the outer case above described, and the nearer the lowest part and the better. There must also be 15 near the boiler a common stop-cock for the purpose of admitting the steam through this steam pipe into the said outer case, or to prevent it when not wanted; by this means it is easy to see that by opening this cock the steam will instantly rush into every part of this outer case (or as it were chimney) in which the pipes are contained, and by its action on every part of the surface of 20 them these pipes may be either thawed when frozen or prevented from freezing, let the season be ever so intense. From the upper or other more convenient part of this outer case must be continued a pipe so as to open a communication between the interior part of the said case and the cistern, so as to convey at the same time the pipes are heated the steam or heated air to pass into the space 25 contained between the cover of the cistern and the water contained in it; by this means the cistern, as well as the pipes appertaining to it, may be either thawed or kept from freezing the same as before observed. This means is applicable with equal convenience and effect to all pipes leading to the wood or other mains in the streets, so that the supply of houses cannot at any time 30 be obstructed unless the said mains themselves are frozen, which seldom is the case when properly laid down within the ground at a sufficient depth below the surface. By this contrivance every family may at a small expence be delivered from a very serious inconvenience in the winter season, and what is of still greater importance, that danger to the inhabitants, and the interruption to 35 commerce occasioned by fixing cocks for the purpose of drawing water in the streets will be totally avoided, and which are doubtless circumstances that will be worthy the consideration of those who have felt the distresses occasioned by long frosts in every city or town supplied with water by pipes, &c. in the present



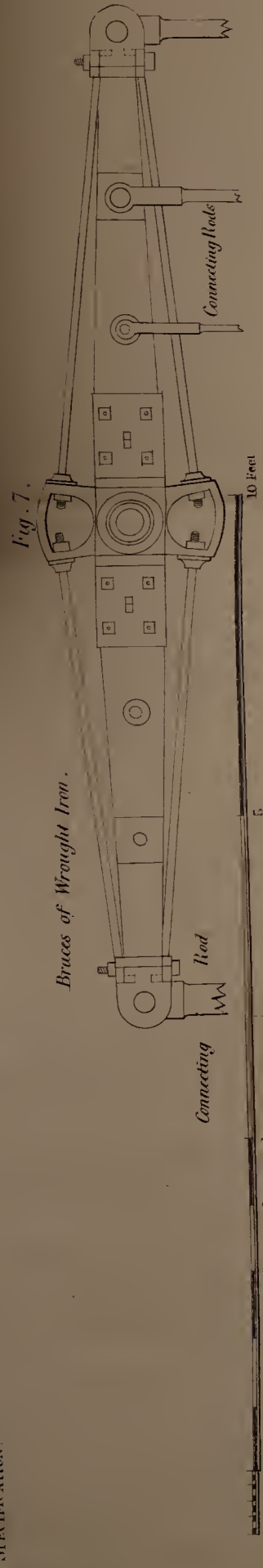


Fig. 4. Is a horizontal section of double Cone as described in Specification  
Fig. 5. Is a vertical section of the same, described as above, and showing how it will be connected with the cylinder in a double acting Engine  
a a. are two reservoirs for oil or grease with apertures communicating to the blank side of the cones.

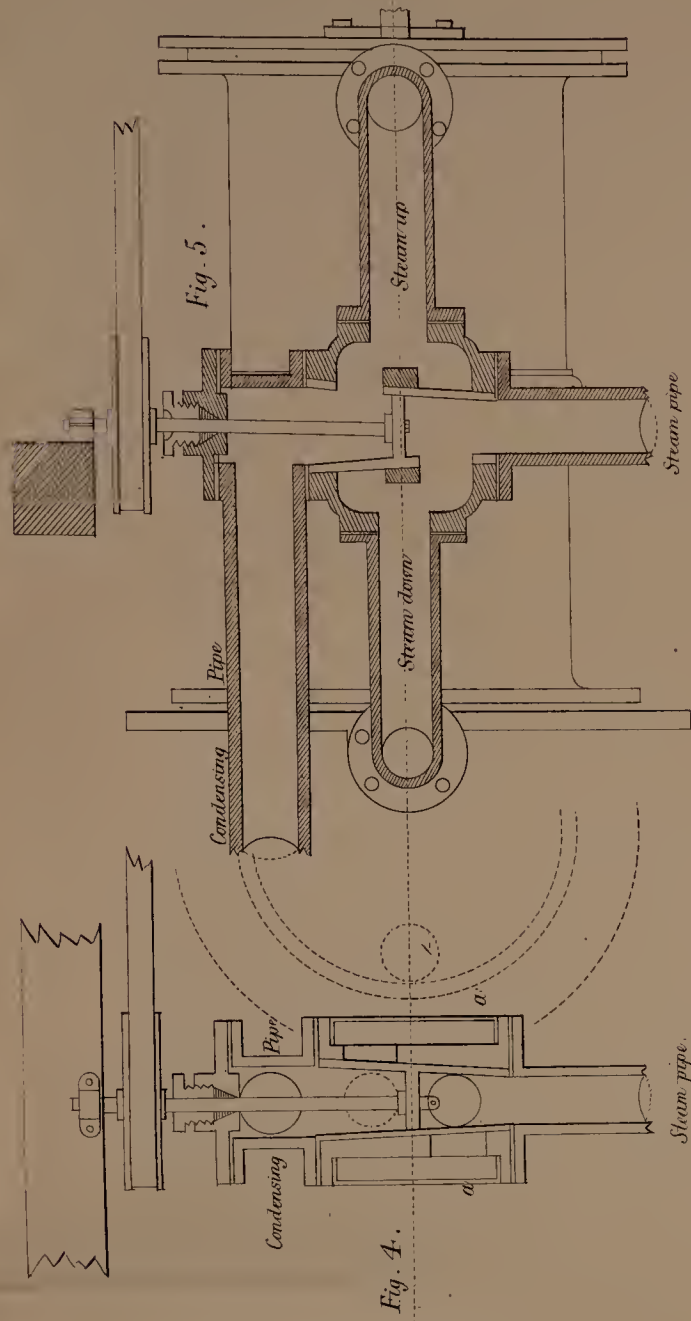


Fig. 6. Shows the cones as they will be connected with the cylinder and working Gear when the Engine is complete.

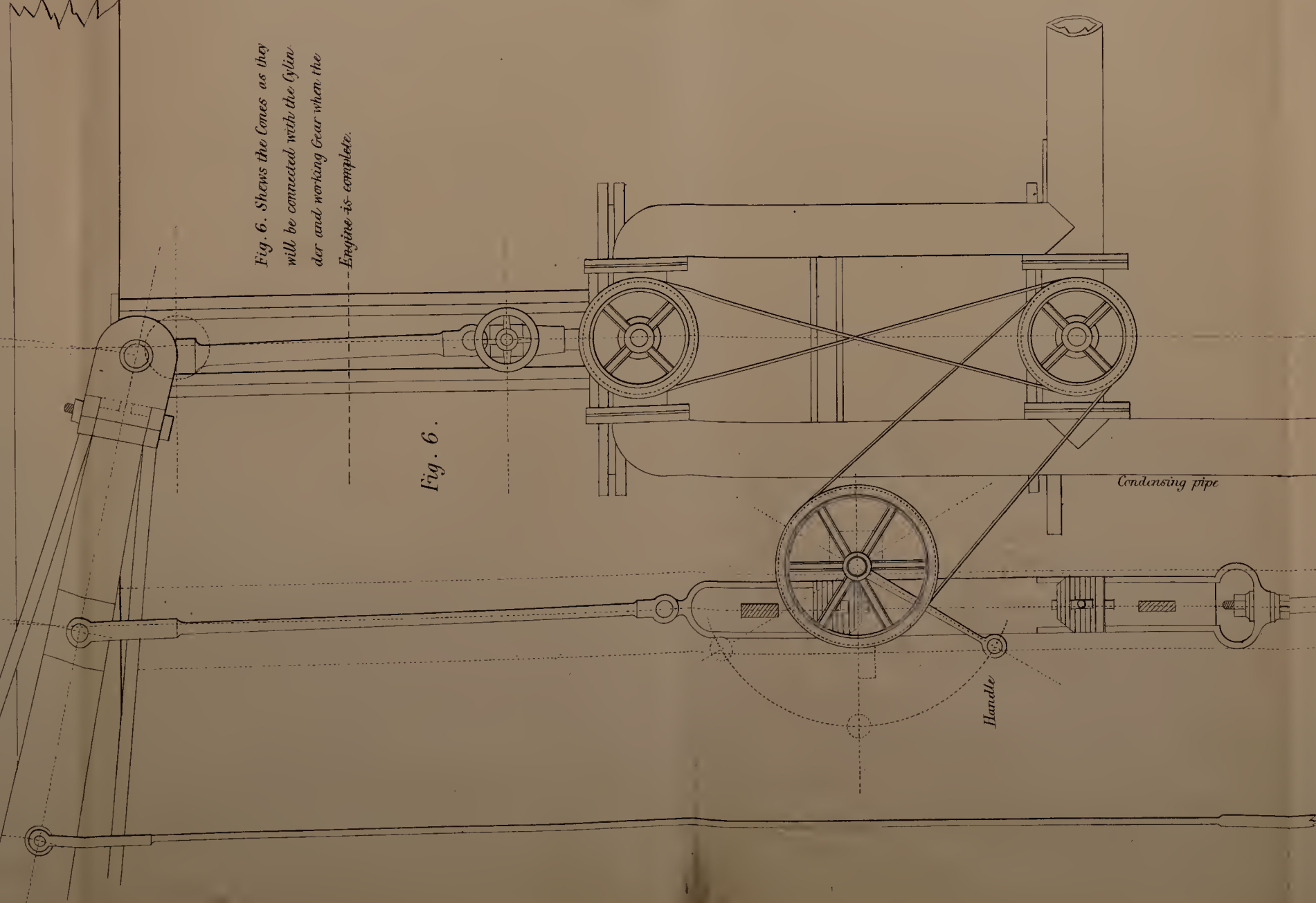


Fig. 2. Shows the vertical section of the single cone and its connection with a single acting atmospheric engine, as described in Specification, & which will also serve to show how it may be connected with a single acting engine of any kind.

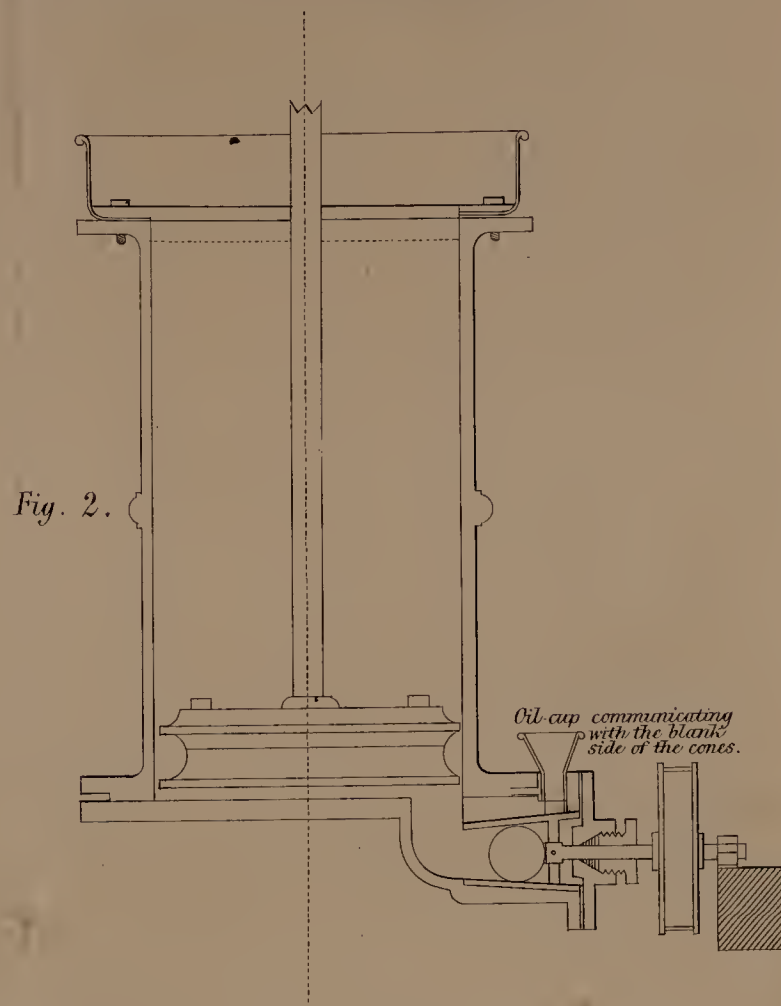


Fig. 1. Shows the horizontal section of the single Cone and the manner of its connection with steam cylinder  
Fig. 3. Shows how two single cones may be applied in a double acting Engine, & how moved in contrary directions as described in Specification.

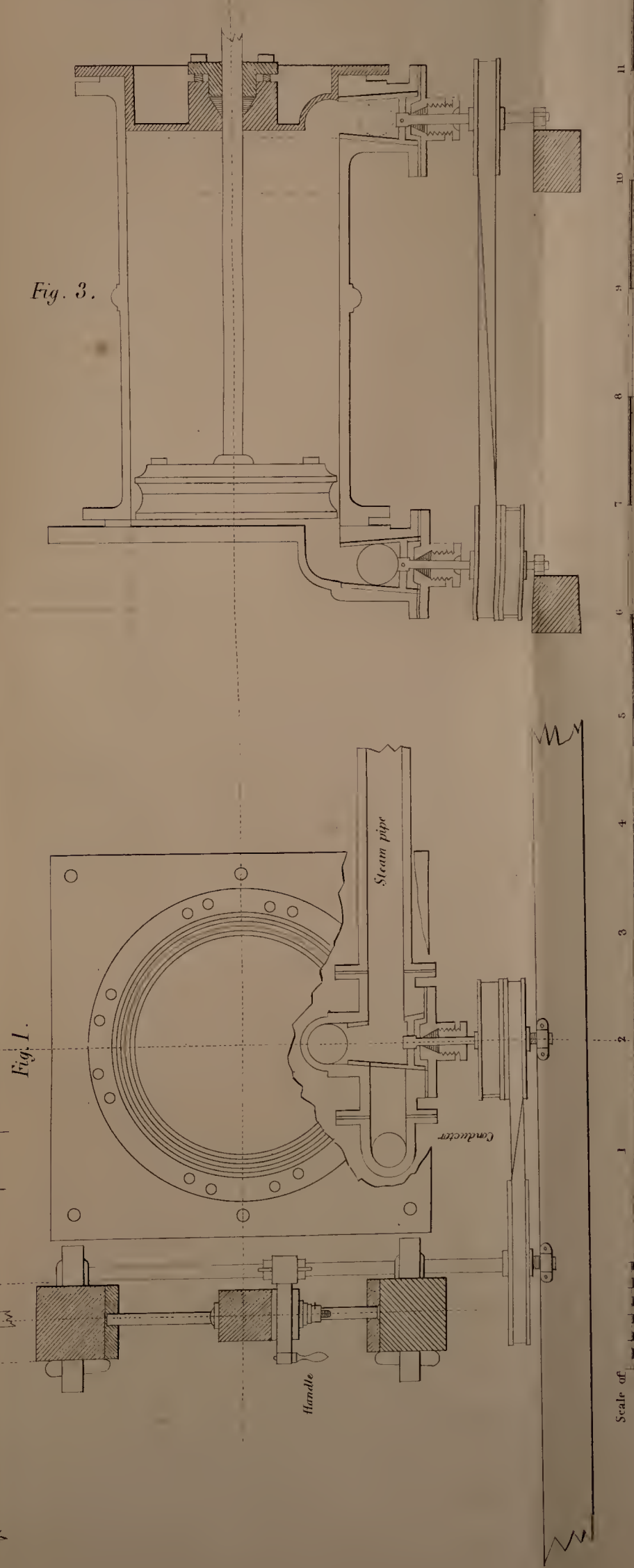
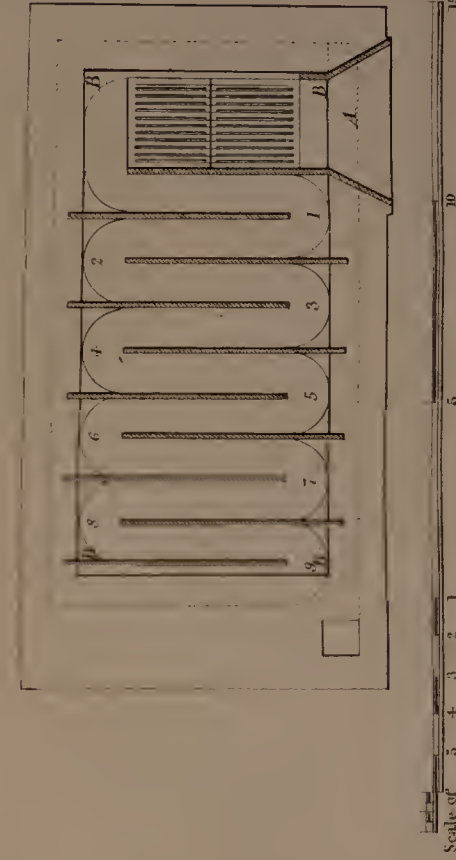


Fig. 8. Shows the plan of the fire place under the bottom of the boiler, and how the effect proposed, and described in the Specification may be accomplished.  
A is the fire place.  
1, 2, 3, 4, 5, 6, 7, 8, 9 are iron bars rivetted to the bottom of the boiler of a sufficient width to form a flue in which the flame is carried backwards and forwards, so as to retard its progress to the surrounding flue. B B B B the square black line represents the bottom of the boiler, and the projecting ends of the ribs are built into the brick work, inter-hungably at opposite sides.









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way. By this method all pipes and reservoirs, casks, jars, &c. used for conveying or holding oils or liquids of every kind may be kept fluid in seasons the most intense. The above means of preventing the effects of frost may be effected by heated air only, without steam, but by no means so effectually.

5 There are also many variations to be made in the accomplishment of the objects of this Patent by dissimilar arrangements in the component parts without altering the effect or deviating from that foundation on which the right of Patents ought to rest, namely, the accomplishment of the objects stated in the Specification.

10 In witness whereof, I, the said Joseph Bramah, have hereunto set my hand and seal, the Twenty-eighth day of December, One thousand eight hundred and one.

JOSEPH (L.S.) BRAMAH.

AND BE IT REMEMBERED, that on the same Twenty-eighth day of  
15 December, in the year above mentioned, the aforesaid Joseph Bramah came before our Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and everything therein contained, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute in that case made and provided.

20 Inrolled the same Twenty-eighth day of December, in the year above written.

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